A4

PATENT SPECIFICATION

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DRAWINGS ATTACHED

1 207 621

(21) Application No. 40755/67 (22) Filed 6 Sept. 1967
(31) Convention Application No. A53448 VIIIb/21d[1] (32) Filed 7 Sept. 1966 in
(33) Germany (DT)
(45) Complete Specification published 7 Oct. 1970
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(54) INDUCTION MOTOR WITH SPHERICAL AIR GAP

SPECIFICATION NO. 1,207,621

By a direction given under Section 17(1) of the Patents Act 1949 this application proceeded in the name of BETEILIGUNGS-AKTIENGESELLSCHAFT FUR HAUSTECHNIK, a Swiss Company of Glarus, Switzerland.

THE PATENT OFFICE R 72

SPECIFICATION NO. 1,207,621

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of STANDARD MAGNET AG, a Swiss Company, of Hünenberg, Switzerland.

THE PATENT OFFICE R 2245

[illegible] endless metal belt or strip.

The invention consists in an induction motor having an armature in the form of a segment of a sphere, an airgap of spherical configuration between the stator and the armature, the stator being formed of spirally wound sheet metal strip having grooves formed therein to accommodate coils, the spiral turns being successively displaced axially to present the desired spherical surface. Advantageously, the sheet metal strip has the grooves punched out thereof and is thereafter wound so that the grooves form slots into which the winding is inserted. The coils in the grooves run on spherical surfaces whereby compact units are achieved and dissipation losses are kept to a minimum. In carrying out the invention the rotor is not made from axial or radial sheet layers following the prior art but is built up substantially hemispherically from segments of solid material. The coils may be replaced by a deep drawn cap made from an electrically highly conductive material.

Further preferred features of the invention are means preventing the rotor from falling

Figure 3 shows an armature in which the iron ring 30 made of magnetically soft iron bears a copper or aluminium coating 31. This coating 31 may have rings 32 and 33 at both ends which serve as short-circuiting rings. Preferably a second coating 34 made of a material of electrically low but magnetically high conductivity is located outside the first coating 31. In the case of pumps, the material is preferably nickel iron which provides at the same time a good protection against corrosion. The bushing 36 is inserted in the hollow body 37 which is supported by the ball 35 which, in turn, is fixed to the stator of the motor. The bushing 36 is preferably made of aluminium oxide, the ball preferably of tungsten carbide, and silver soldered to the small tube 39. The coating 34 can be replaced by a plastic layer filled with soft magnetic material.

Figure 4 shows another type of the armature which is built up from segments 45 of sintering iron. Between each pair of neighbouring segments there is a channel 40 through which runs a bar 41 of the squirrel cage coil, the bar being electrically connected to the short-circuiting rings 43 and 44.

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(54) INDUCTION MOTOR WITH SPHERICAL AIR GAP

(71) We, ACCESSAIRSA, a Swiss company of Grohaus am Kolinplatz Zug, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to induction motors with spherical air gap. Motors with spherical air gap are of special interest for applications in which the armature is to execute tumbler movements, such as above all grinders and polishers as well as pumps and blowers. Motors possessing a spherical air gap are known; however, their disadvantage is the fact that the stator consisting of sheet metal layers is made up from a multitude of sheet metal parts of different internal diameters. As each of these sheet metal parts requires a special punching tool, these motors have scarcely been realised in practice.

On the other hand there are so-called axial gap motors whose stators are wound from an endless metal belt or strip.

The invention consists in an induction motor having an armature in the form of a segment of a sphere, an airgap of spherical configuration between the stator and the armature, the stator being formed of spirally wound sheet metal strip having grooves formed therein to accommodate coils, the spiral turns being successively displaced axially to present the desired spherical surface. Advantageously, the sheet metal strip has the grooves punched out thereof and is thereafter wound so that the grooves form slots into which the winding is inserted. The coils in the grooves run on spherical surfaces whereby compact units are achieved and dissipation losses are kept to a minimum. In carrying out the invention the rotor is not made from axial or radial sheet layers following the prior art but is built up substantially hemispherically from segments of solid material. The coils may be replaced by a deep drawn cap made from an electrically highly conductive material.

Further preferred features of the invention are means preventing the rotor from falling from its support when the current is switched off, the construction of waterproof motors of the described type, and means for improving the cooling of such motors as well as their application to wet tool grinders.

The invention is further described and explained in more detail with reference to the following figures:—

Figure 1 is a section of a pole ring made up from an endless sheet metal strip with punched grooves, the metal strip being wound to a geometrical spiral as it is known; but at the same time according to the invention each layer is axially shifted from the next one in such a way that the limiting areas 1 and 2 are located on spherical surfaces.

Figure 2 is a view of the pole ring as per figure 1, seen from the direction of the air gap. The coils 21 and 22 run through the grooves 20 and are shaped in such a way that they folow the limiting line 3 in figure 1.

Figure 3 shows an armature in which the iron ring 30 made of magnetically soft iron bears a copper or aluminium coating 31. This coating 31 may have rings 32 and 33 at both ends which serve as short-circuiting rings. Preferably a second coating 34 made of a material of electrically low but magnetically high conductivity is located outside the first coating 31. In the case of pumps, the material is preferably nickel iron which provides at the same time a good protection against corrosion. The bushing 36 is inserted in the hollow body 37 which is supported by the ball 35 which, in turn, is fixed to the stator of the motor. The bushing 36 is preferably made of aluminium oxide, the ball preferably of tungsten carbide, and silver soldered to the small tube 39. The coating 34 can be replaced by a plastic layer filled with soft magnetic material.

Figure 4 shows another type of the armature which is built up from segments 45 of sintering iron. Between each pair of neighbouring segments there is a channel 40 through which runs a bar 41 of the squirrel cage coil, the bar being electrically connected to the short-circuiting rings 43 and 44.

Figure 5 shows how the armature is built up from segments 45 to a ring before the coil 41, 43, 44 is cast in.

Figure 6 shows a motor according to the invention applied to a hand polisher. Once more the spiral 21 and the coil 60 below are visible. A sheet iron dissipating ring 61 touching the poles of the stator will prevent harmonic waves.

The pivoting angle of the armature 30 is limited by the shell 62 and the small tube 37. The stator 21 and the coil 60 are located in a housing 64 of heat conductive material. The inside of the housing 64 is seperated from the armature by a thin waterproof sheet metal partition 65. This partition 65 is made either of a non-magnetic material, such as chrome-nickel steel, or—according to the invention—preferably of a material of low magnetic conductivity. In this way the lines of the magnetic forces are more uniformly distributed over the area of the air gap 66, so that the magnetic saturation in the air gap is lower, and in total higher magnetic forces are allowed to arise. The inside diameter of the ring 67 is somewhat smaller than that of the ball, and it is held in its place by means of the ring-shaped screw 68. Its axial distance to the spherical surface is large enough to prevent friction in operation. As soon as the motor is switched off, the ring 67 prevents the falling out of the armature 30 with the polishing disc support 69 and the polishing disc itself—not shown—which is located in the plane 70.

Figure 7 shows an armature which consists of an iron forged or sintered part 71 bearing a one-piece copper or aluminium coil 72. The projecting parts 73 are taken up by recessions in the iron part 71.

Figure 8 shows the coil part which has been punched from a hemispherical cup without the iron part 71. The rings 80 and 81 effect the short-circuit of the induced currents.

Figure 9 shows a pump incorporating a motor according to the invention. Once more, the stator 3 is constructed as shown in Figure 1; for instance, the coil 21 and the layer 22 which is located axially beside it are arranged as shown in Figure 2. Together with the thin partition 65 the motor housing 90 forms a watertight space in which a rubber ring 91 is pressed into the rotating corner area by means of an aluminium ring 92. Equally, the small tube 93 is conically expanded at the ends and becomes a waterproof seal together with the ruber rings 94. The aluminium ring 95 leads over to the aluminium ring 92 and the housing 90. Ring areas of the aluminium rings 92 and 95 are directed radially towards the centre and reach the periphery of the iron stator 3; they are thus located between the lower coil layer 22 and the upper coil layer, so that heat transfer from the coils 21 and 22 to the wall of the housing 90 is ensured. The housing 90 is connected to a ring 130 and held at the defined distance by three tubular rivets 195 which are spaced on the periphery. A rubber ring 125 is inserted in this ring 130 and forms an annular gap 82 together with the cover plate 96 of the pump rotor 97. As long as the curent is switched on, the armature 10 is attracted in the direction of the arrow 128, and the spring 127 pressing the bushing 12 to the top is put under pressure. As soon as the current is switched off, the axial magnetic component 128 is eliminated, and the unit consisting of the armature 10 and the pump rotor 97 with the blade cascade 80 and the cover plate 96 is shifted towards 129 and pressed against the ring 125 by means of the spring 127, so that noise is prevented. If dirt particles penetrate into the gap 82, the armature executes a tumbling movement around the ball 9, so that the dirt particles are automatically removed. The ball 9 and the bushing 12 are preferably made from materials of a hardness which is greater than the hardness of possible additions to the liquid to be moved. The lead 100 representing the connection to the electrical power supply is safely protected against the liquid by means of a screw connection 101 and a ring 102 bearing two rubber rings; a bypass between the suction side 135 and the discharge side 134 can be effected by openings 131 which can be closed by a ring 132 which, in turn, is preferably spring mounted, so that the liquid is not allowed to flow back through the wall 130. If, on the other hand, the maximum pressure is intended to be low, the ring 132 is lifted by means of the screw 133, so that part of the liquid is allowed to flo wback from the discharge side 134 to the suction side 135.

The pump housing consists of two identical cups 120 and 121 which are axially connected by a ring 122 and sealed by a rubber ring 123. In order to win the twist energy back, a cascade of guide vanes 103 is provided to effect a deflection of the entering flow to a direction which runs approximately axial to the pump. The wire net 105 is intended to screen off the dirt.

Figure 10 is the development of a cascade of guide vanes 103 punched in a continuous process corresponding to the profile 106, the vanes 107 being not only punched but also bent. The twist flow 108 is deflected to the direction 109, at the same time securing a presure gain.

WHAT WE CLAIM IS:—

1. An induction motor having an armature in the form of a segment of a sphere, an air gap of spherical configuration between the stator and the armature, the stator being formed of spirally wound sheet metal strip having grooves formed therein to acc-

ommodate coils the spiral turns being successively displaced axially to present the desired spherical surface.

2. A motor as claimed in claim 1 in which the sheet metal strip has the grooves punched out thereof and is thereafter wound so that the grooves form slots into which the winding is inserted.

3. An induction motor as claimed in either of the preceding claims wherein the armature is in the form of a segment of a sphere and is coated with a material of high conductivity.

4. An induction motor as claimed in claim 3 wherein the armature is a soft iron piece forming a segment of a sphere and has a further coating made from a material of high magnetic but low electrical conductivity.

5. An induction motor as claimed in claim 1 or claim 2 having an armature characterised by a shell exceeding the axial length of the armature and containing bearing means.

6. An induction motor as claimed in claim 1 or claim 2 having an armature incorporating a bearing which forms a universal link, and whose centre of gravity coincides approximately with the centre of the sphere pertaining to the said spherical surface.

7. An induction motor as claimed in claim 1 or claim 2 having an armature in the form of a segment of a sphere built up from soft magnetic segments forming between them, on a cone-shaped shell, channels into which a highly conductive material is cast.

8. An induction motor as claimed in claim 1 or claim 2 having an armature consisting of segments, characterised in that said segments are made from sintering iron.

9. An induction motor as claimed in any of the preceding claims and wherein the stator is enclosed in a housing and has a spherical wall of a non-magnetic material towards the armature.

10. An induction motor as claimed in any of claims 1 to 8 wherein the stator is enclosed in a housing and has an extremely thin wall of a soft-magnetic material towards the armature.

11. An induction motor as claimed in claim 9, characterised in that heat transfer means are located between the stator coil layers and have a highly heat conductive connection to the wall of the housing in order to dissipate the coil heat.

12. An indication motor as claimed in claim 11 wherein the heat transfer means consists of two rings of L-shaped cross section.

13. An indication motor as claimed in claim 1 or claim 2 wherein the armature is mounted by bearing means consisting of a bushing and a ball, the said ball being soldered to a tube.

14. An induction motor as claimed in claim 13 wherein a ring is provided which will not touch the ball when the motor is switched on but will prevent the falling out of the rotating part when the motor is switched off.

15. A polishing device incorporating a motor as claimed in any of the preceding claims wherein the armature is rigidly connected to a polishing disc.

16. A pump incorporating a motor as claimed in any of claims 1 to 14 wherein the motor is concentrically mounted in a housing consisting of two similar bodies to which pressure and suction ducts are affixed.

17. A pump incorporating an induction motor as claimed in any of claims 1 to 14 characterised in that a bushing effects an axial shifting of the armature via a spring when the motor is switched off.

18. A pump incorporating a motor as claimed in claim 13 wherein the pump rotor has a cover whose suction area is shaped to form a generally spherical surface, the centre of the sphere coinciding approximately with the centre of the said ball.

19. A pump incorporating a motor as claimed in claim 17 wherein the pump rotor has a cover whose suction area is shaped to form a generally spherical surface, the centre of the sphere coinciding approximately with the centre of a ball forming part of the mounting of the motor armature and a ring made from a flexible material, for instance rubber, is inserted in a rigidly mounted ring connected to the housing.

20. A pump incorporating an induction motor as claimed in any of claims 1 to 14 wherein a wall separates the suction side of said pump from the pressure side thereof, the said wall being provided with openings which are closed by a ring, means being provided to move said ring from its place, so that a bypass flow can take place through the said openings.

21. An induction motor substantially as herein described with reference to and as shown in the accompanying drawings.

22. A polishing device incorporating an induction motor substantially as herein described with reference to and as shown in Figure 6 of the accompanying drawings.

23. A pump incorporating an induction motor substantially as herein described with reference to and as shown in Fgures 9 and 10 of the accompanying drawings.

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1207621 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1.

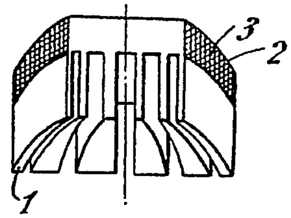
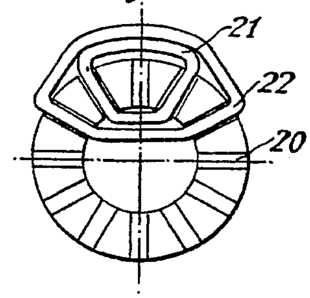


Fig.2.



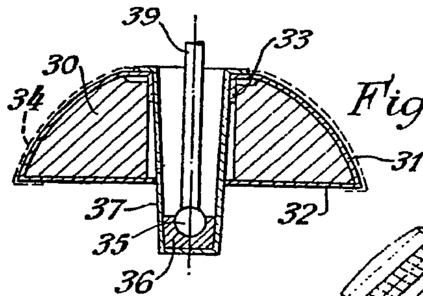


Fig.3.

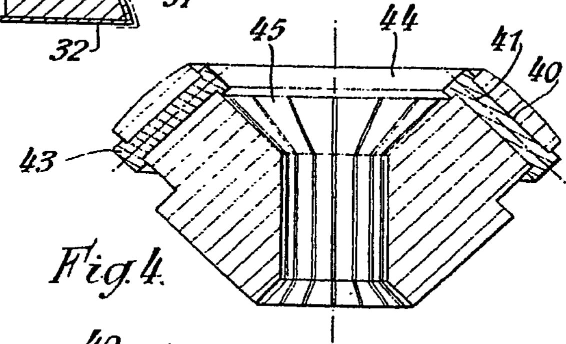


Fig.4.

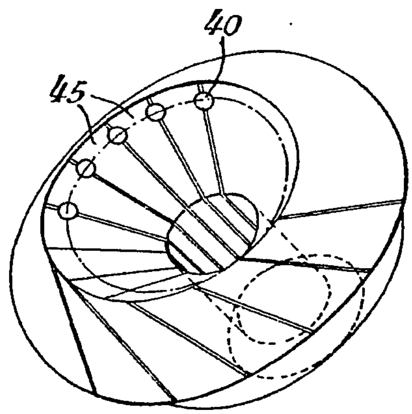


Fig.5.

1207621 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

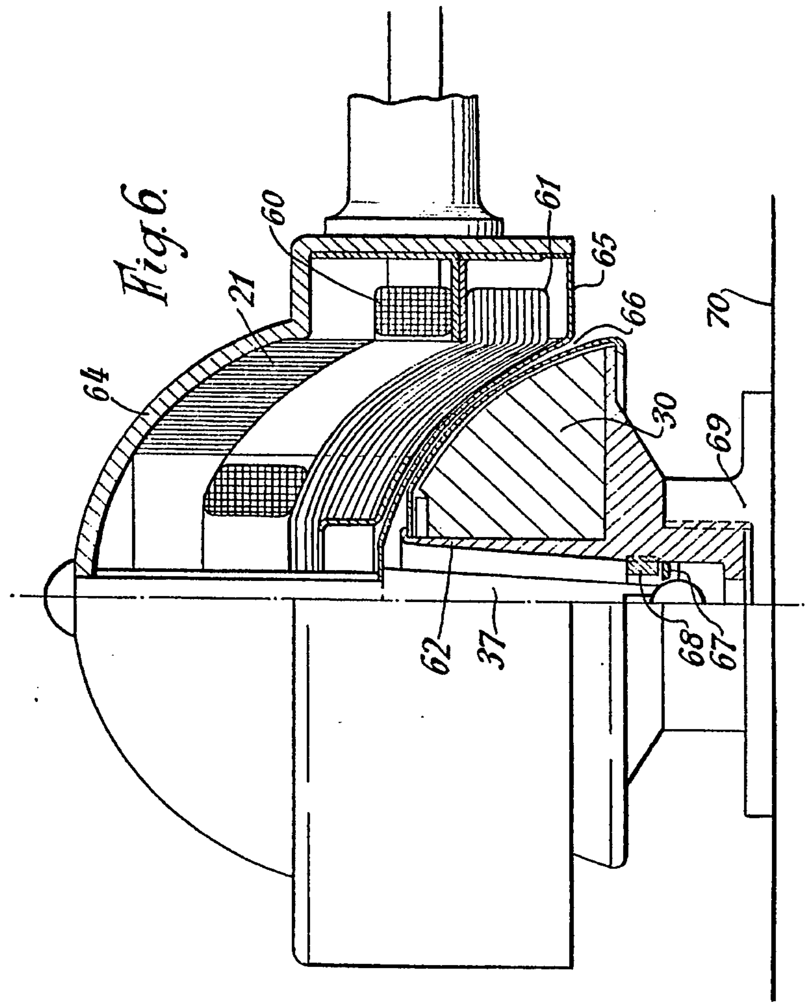


Fig.6.

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Fig.9

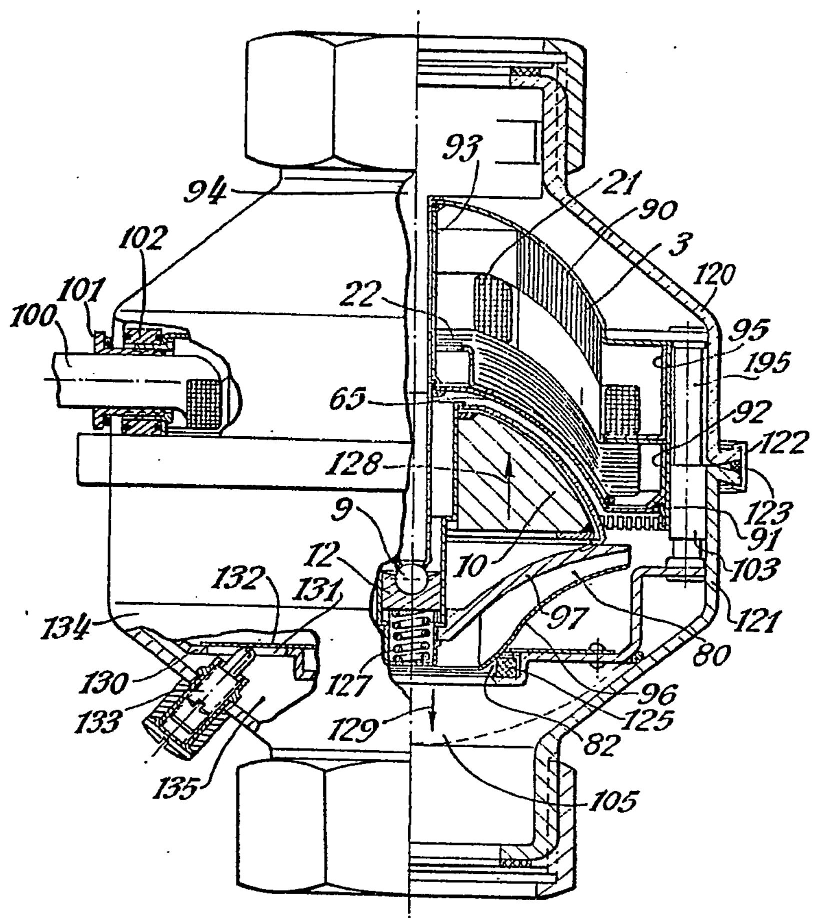
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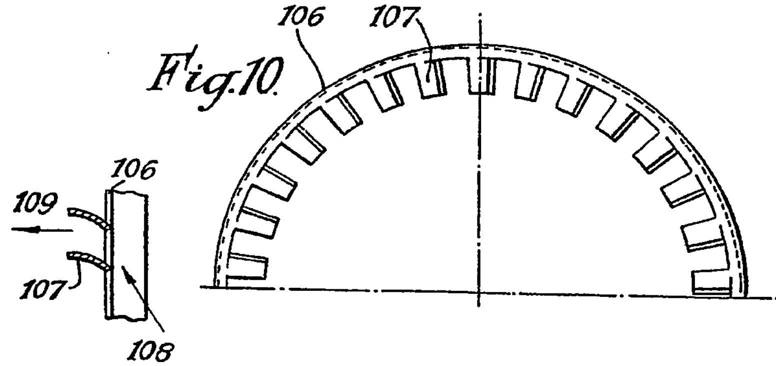
Fig.10.



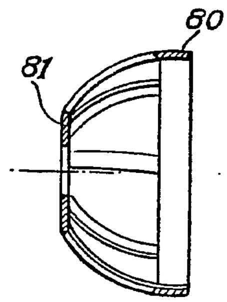


Fig.8.

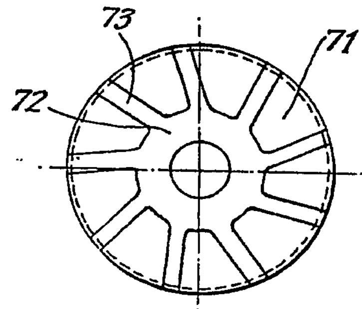


Fig.7.